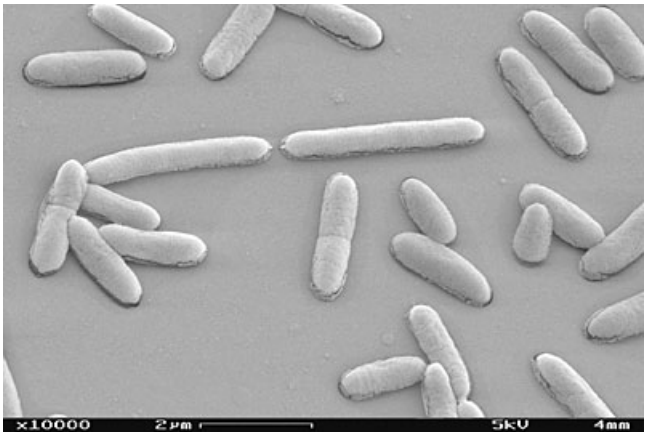


Frank Roberto trawls Yellowstone's thermal pools for viruses and microbes. On a recent trip to the park, he hunted for bacteria that could aid in the production of biofuels and bioplastics. Image courtesy of Manfred Rohde/Joint Genome Institute.

Probing life's extremes in Yellowstone

by Mike Wall, *INL Research Comunications Fellow*

Idaho National Laboratory biologist Frank Roberto squats on a bare, gravelly patch of ground in Yellowstone National Park's rolling backcountry. At his feet, scalding water churns in a mustard-yellow pool the size of a wheelbarrow.

Roberto dips a small plastic vial into the pool by hand, scooping up a half-cup of water. He caps the vial, then slides it into the red backpack sitting beside him on the cracked earth.

No two pools in Yellowstone are alike. They vary tremendously in size, color, temperature and acidity.

"That's a good sample," he says. "We should get something out of this one."

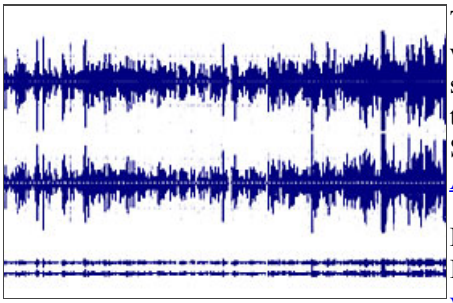
Roberto has been studying Yellowstone's hot springs for two decades. These days, he usually keeps more of a distance, affixing his vials to the end of a long yellow pole. But he's still after the same thing: microbes and viruses. Even the most inhospitable pools here — the boiling-hot ones with the same pH as stomach acid — are seething with microscopic life.

Every one of Yellowstone's 10,000 hot springs is a distinct ecosystem, and Roberto wants to know how they all work. How, for example, do the various species survive such extreme conditions, and how do these organisms interact with each other and the landscape? He and his colleagues have made a series of intriguing discoveries over the years. They've found many new virus species, one of which may give scientists a fresh perspective on the origins of life on Earth. And they've isolated virus DNA from the vapor wafting off some pools' surfaces, suggesting viruses are hopping from spring to spring on flying carpets of steam.

On this warm, cloudy day in early August, Roberto is more interested in bacteria than viruses. He's hoping to collect several different strains of one particular species, with the aim of finding a strain whose DNA he can tweak. He wants to genetically manipulate the microbe into helping with biofuel and bioplastic production.

"Let's do this one," Roberto says, pointing to a cloudy, pale-green pool as big around as a Jacuzzi. "It's got some floating black stuff. That's my scientific term, floating black stuff."

He's speaking to four university students who have come along on today's trip, INL summer interns getting a taste of fieldwork. One picks up the yellow pole, and another opens a field notebook, ready to transcribe. The other two start measuring the water's temperature and pH, while Roberto pulls a GPS unit out of his pack.



Listen to a podcast about Frank Roberto's Yellowstone research. Read the podcast transcript.

The students chat and joke around, but they work quickly, with a practiced efficiency. They know what they're doing, both in the field and in the lab; Roberto has trained them well. This isn't surprising. He enjoys being a mentor and takes the role seriously, knowing that he's helping to shape the minds and careers of a new generation of scientists. The U.S. Department of Energy's Office of Science recognized Roberto's dedication recently, giving him its prestigious Outstanding Mentor Award a few days after this Yellowstone trip.

His mentoring efforts and a variety of different projects have kept Roberto busy since he came to INL in 1988. He has studied, for example, the feasibility of using thermal-pool bacteria to separate valuable metals from ore. He helped develop a quick, easy-to-use method to identify animals infected with brucellosis, a serious disease that can decimate livestock and wildlife populations and sometimes jumps to humans. And Roberto has worked to put mussels' powerful, waterproof adhesive — the stuff the mollusks use to stick to rocks and ship hulls — to work for humans. He has identified several important glue proteins and goosed microbes into producing them, a process for which he holds several patents with fellow INL biologist Heather Silverman.

But Roberto isn't chained to the lab bench. He has been practicing aikido for 28 years and now teaches the martial art in Idaho Falls. He loves hiking, whitewater rafting and canoeing in the wilds of the Northern Rockies. And he's a fairly serious climber, having summited Wyoming's steep and craggy Grand Teton. So he loves his research trips to Yellowstone — they give him a chance to indulge his passion for science, wildlife and the out-of-doors.

At about 2 p.m., a lone male bison crests a small rise and comes ambling toward the pool Roberto and his students are sampling. The animal moves slowly, without obvious malice, but the team beats a prudent retreat behind a fallen tree a hundred yards away. Bison are powerful animals, and you never know what they're going to do. The researchers watch as the bison wanders off, sinking to its knees in a sandy spot at the base of a hill. It rolls and wallows, hooves in the air, seemingly enjoying its bath in the geothermal dirt.

"It's never the same," Roberto says, smiling as he watches the bison. "Every time you come out here, there's some new adventure."

Read the slideshow transcript.

Feature Archive